

## Distribution and Range Reduction in Victoria of the Eltham Copper Butterfly *Paralucia pyrodiscus lucida* Crosby

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### Abstract

The geographic range of the Eltham Copper Butterfly, *Paralucia pyrodiscus lucida*, in Victoria is reviewed on the basis of historical records and from field surveys in 1987-88. The subspecies is recorded from eight localities but only three disjunct populations are now known to exist. The populations are fragmented and occur in mixed eucalypt woodland and open forest habitats of central and western Victoria in which the mean annual rainfall varies from 420-750 mm. Habitat loss, through extensive agriculture and urbanisation, is implicated as the main factor for the loss of known populations. Preliminary observations on the male hindwing phenotype suggests *P. p. lucida* may form part of an extensive coastal-inland cline with populations in New South Wales and central Queensland. Despite taxonomic difficulties the Victorian populations, as currently defined, should be regarded as vulnerable.

### Introduction

The Eltham Copper Butterfly, *Paralucia pyrodiscus lucida* Crosby (Lepidoptera: Lycaenidae) (Fig. 1), is currently regarded



Fig. 1. Male Eltham Copper Butterfly *Paralucia pyrodiscus lucida* near Melbourne. Photo: M.F. Braby.

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as a subspecies or geographical race of the Dull Copper Butterfly, *Paralucia pyrodiscus pyrodiscus* (Doubleday), (nomenclature of Edwards 1991). The species is uncommon but widely distributed in eastern and southeastern Australia (Common and Waterhouse 1981). The nominate subspecies occurs from central Queensland (Bauhinia Creek 10km E of Boolburra, 23°44'S, 149°47'E, near Duaringa; Expedition Range; Kroombit Tops) (Atkins 1974, 1976, Monteith and Yeates 1986) to eastern Victoria (Nowa Nowa, 37°44'S, 148°05'E, near Lakes Entrance) (Crosby 1951a, b), and as far inland as Mount Moffatt National Park in central Queensland (Monteith and Yeates 1988) and Warrumbungle National Park in central New South Wales (Daniels and Moulds 1977). More recently, it has been collected farther north at 11km WNW of Herberton (17°20'S, 145°17'E) at 750 m on the Atherton Tablelands in north-eastern Queensland (Wood 1992), and E.D. Edwards captured four males at Kenebri Salt Caves (30°45'S, 149°17'E) in the Pilliga Scrub of inland New South Wales on 22 October 1989 (specimens lodged in Australian National Insect Collection). The early reference to Bowen, northern Queensland, by Waterhouse (1903), may have been documented in error as the locality was not listed in subsequent works (Waterhouse and Lyell 1914, Waterhouse 1932, Common and Waterhouse 1972, 1981). By contrast, *P. p. lucida* is much more restricted in distribution being geographically separated, known only from central and western Victoria (Crosby 1951a, Common and Waterhouse 1981), and is currently threatened (New 1991, Braby and Crosby, in press).

The purpose of this account is to provide an historical overview of the distribution and occurrence of *P. p. lucida*, to speculate on which factors have led to its decline and briefly describe its habitat

preference. This treatment is essential for establishing precise distributional data for a species which is poorly represented in the state as a whole. Moreover, the early records give some indication of causal factors contributing to local extinction and population contraction. We also discuss problems associated with the variation and taxonomic status. We build on, rather than recapitulate, information in two previous reports (Crosby 1987, Vaughan 1988).

### Methods

Information on geographical distribution was collated from four main sources: (a) published records, (b) label data from specimens held in the Museum of Victoria, Melbourne (MVM), Australian National Insect Collection, Canberra (ANIC), Australian Museum, Sydney (AMS), Queensland Museum (QM), James Cook University, Townsville (JCU) and the British Museum (Natural History), London (BMNH), (c) from observations made by collectors and naturalists, and (d) field surveys. All localities from which the species was known, and some intervening areas, were examined by the authors between November 1987 and February 1988. Overall, 219 sites distributed throughout the Melbourne, Wimmera, Ballarat and North-central regions of Victoria were assessed for the presence of the butterfly. Survey effort was based primarily on the occurrence of the known preferred habitat, identified from vegetation maps (from Land Conservation Council reports) and from the Melbourne Flora Survey Unit records, as well as on the distribution of the particular form of the host plant, *Bursaria spinosa* Cav. (Pittosporaceae) (Braby 1990). Sites identified by members of the public in response to media reports requesting residents to check for butterfly colonies on their properties were also examined.

### Variation and taxonomic status

The main criterion used for separating the two subspecies was based on the extent and variability of copper scales on the

hindwing upperside of males. *P. p. lucida* was considered to have a consistent and well defined bright patch of coppery scales, whereas *P. p. pyrodiscus* had an ill-defined (i.e. dull) central copper area often reduced to only a mere suffusion of copper scales, with the extent of the copper area being individually variable (Crosby 1951).

The distribution of the two subspecies, however, has met with some difficulty. McCubbin (1971) suggested that *P. p. lucida* was a distinct race confined in its entirety to the north-eastern suburbs of Melbourne. While acknowledging that specimens from Kiata and Dimboola in western Victoria may belong to this race, he nevertheless placed them under *P. p. pyrodiscus*. Common and Waterhouse (1972, 1981), however, in a more formal treatment of the species, later assigned these specimens, to *P. p. lucida*. Atkins (1974, 1976) also expressed opinion that material taken from the Expedition Range, central Queensland, was better placed with "*lucida*" than with coastal populations of the typical race, but this was not accepted by Common and Waterhouse (1981).

During the course of collecting distributional data from material held at ANIC, AMS, MVM and QM, these disparities in opinions became even more apparent. Waterhouse (1903) first noted that *P. pyrodiscus* was a variable butterfly, and this was particularly evident amongst northern populations. For example, a number of *P. p. pyrodiscus* specimens from localities in New South Wales and Queensland exhibited a degree of hindwing copper scaling which was best described as "intermediate" between the very bright specimens from Melbourne (Eltham, Greensborough) and the very dull examples from eastern Victoria (Nowa Nowa, Mallacoota). In some areas in New South Wales (e.g. Sydney district, Menangle Park, Mulgoa, Armidale) and Queensland (e.g. Glen Aplin, Kroombit Tops) males from the same locality resembled either of these two forms. Moreover, males from the more inland areas (Qld.-Mount Moffatt National Park, Eidsvold, Millmerran, Stanthorpe; N.S.W. Pilliga Scrub) approached *P. p.*

lucida, while the typical dull specimens were largely confined to moister coastal areas from south-eastern Queensland through New South Wales to eastern Victoria. Material taken recently from Expedition Range (Blackdown Tablelands), inland central Queensland, by M.F. Braby indicated that males from this locality more closely conformed to the dull coastal examples from Brisbane and farther south. Specimens from Herberton, north-eastern Queensland, however were distinctive, being considerably darker above (especially in females) compared with any other known populations, and this population perhaps warrants recognition as a distinct ecological form or even subspecies.

### Geographic distribution

The distribution of *P. p. lucida*, together with *P. p. pyrodiscus* in Victoria, is shown in Figure 2. *P. p. lucida* was recorded from eight locality areas in central and western Victoria. However, populations no longer existed at five of these localities (Table 1) and the subspecies geographic range has almost certainly contracted, now confined to three disjunct areas. These populations were very fragmented and the constituent colonies occurred in very small isolated habitat blocks. No new localities were revealed from our survey, but one

population was rediscovered. Remnant habitat blocks, which have not been exhaustively surveyed, occurred between the known populations (e.g. Bendigo-Heathcote district) and it is possible that continued searching may yield additional sites.

### Past records

(a) Goulburn Valley (Tallarook). The first Victorian record for *P. pyrodiscus* was from the "Goulburn Valley" region. Anderson and Spry (1893-94) stated that "...it has been found to occur freely in the Goulburn Valley..." but gave no precise locality details or dates. The only specimens which confirm this record are two males labelled "Goulburn Valley, Feb. 1893, Meyrick Collection" (BMNH); one specimen had an additional label "JAK". The specimens were apparently taken near Tallarook (37°06'S, 145°06'E) in the vicinity of the Goulburn River in central Victoria (A.N. Burns, pers. comm. 1989). It is unlikely that the butterflies were taken by Meyrick (*P. Ackery*, pers. comm.) and were probably collected by G. Lyell (who later gave them to Meyrick) and identified by J.A. Kershaw (K. Walker, pers. comm.). Burns felt that E.

**Table 1.** Locality records for which *Paralucia pyrociscus lucida* is presumed extinct. MVM = Museum of Victoria (Melbourne), AMS = Australian Museum (Sydney), ANIC = Australian National Insect Collection (Canberra), BMNH = British Museum, Natural History (London).

Locality	Date	Collector	Source	No. of Specimens	
				male	female
Goulburn Valley	Feb.1893	J.A. Kershaw (Meyrick Coll.)	BMNH	2	
Goulburn Valley	—	—	Anderson & Spry (1893)		
Murtoa	1906	J.A. Hill	K. Hateley (pers. comm.)		
Dimboola	20 Nov.1907	G.A. Waterhouse	AMS	7	
Dimboola	20 Nov.1907	G. Lyell	MVM*		1
Dimboola	Nov. 1907	—	Waterhouse & Lyell (1908)	12	
Keilor	30 Dec.1920	L.B. Thorn	MVM	3	
Broadmeadows	7 Jan.1922	A.N. Burns	AMS	2	2
Broadmeadows	7 Jan.1922	A.N. Burns	A.N. Burns (pers. comm.)	8	6
Total				34	9

\* The labels do not show the name "G. Lyell" but the writing is clearly that of George Lyell.

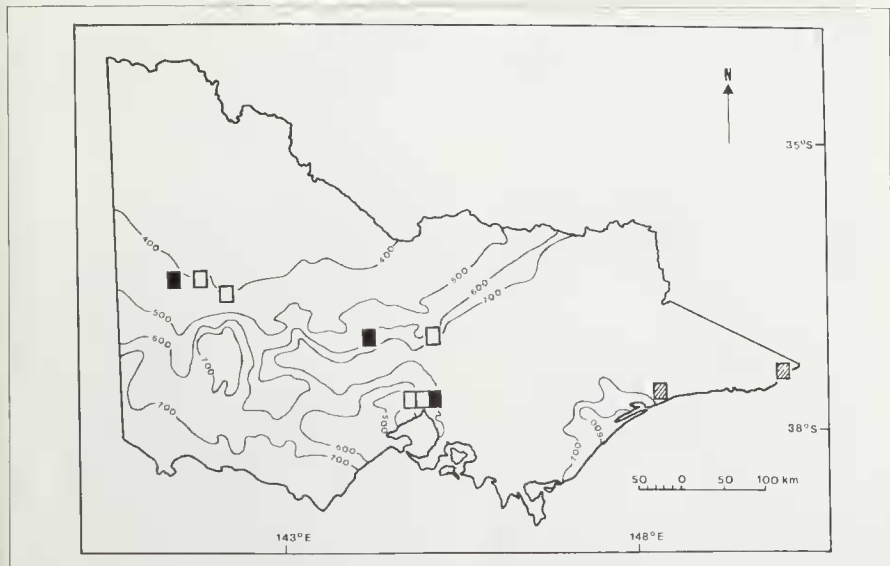


Fig. 2. Distribution of *Paralusia pyrodiscus* in Victoria: ssp. *lucida* (present occurrence (■) and presumed extinct (□) and ssp. *pyrodiscus* (▨). Mean annual rainfall isohyets 400-700 mm are shown (from Lee 1982). All localities are plotted on 10'x 10' grids.

Anderson and F.P. Spry also collected the species from the same area around 1893, just prior to publication of their book. The absence of any further records for almost 100 years from this well collected area suggests the species is now extinct in the region.

(b) Murtoa. Specimens of *P. p. lucida* were apparently collected "adjacent to the railway line" near Murtoa (36°37'S, 142°29'E), around 1906-07 by the late J.A. Hill of Kewell (K. Hateley, pers. comm. 1987). There are no other records and the original specimens could not be traced. Little natural vegetation remains in the area and the species must now be presumed locally extinct.

(c) Dimboola. The Museum of Victoria and the Australian Museum hold twelve and eight specimens respectively, which were collected on 20 November 1907 at Dimboola (36°27'S, 142°02'E) during an expedition by G.A. Waterhouse, G. Lyell and Frichot (see Waterhouse and Lyell 1908). Again, this is the only record for

the locality. We were unable to find any colonies or suitable habitat and the species is almost certainly extinct in the area.

- (d) Keilor. The only record for Keilor (37°43'S, 144°50'E) is five specimens labelled "Keilor, 30 Dec. 1920, L.B. Thorn" (MVM). The butterflies were collected near the Maribyrnong River in a "small open grassy area with some stunted bursarias, now given way to vegetable growing" (A.N. Burns, pers. comm. 1989). A concentrated search along the Maribyrnong River where some remnant but degraded vegetation occurs yielded few bursarias but no butterfly colonies (much of the natural habitat in the district has been removed for agricultural purposes). With increased development and urbanisation over the past 70 years the species must now be considered locally extinct.
- (e) Broadmeadows. Sixteen specimens (2 in AMS; 14 in A.N. Burns' private collection) were collected at

Broadmeadows (37°40'S, 144°55'E) by A.N. Burns on 7 January 1922. The specimens were taken "within 100-300 yards due west of the railway station where some small stunted bushes of *Bursaria* occurred" in an area "where the Leisure Centre and Community Health Centre now stand" (A.N. Burns pers. comm. 1988). Intensive searches along the banks of the Moonee Ponds and Yurokee Creeks where some scattered plants of *B. spinosa* occur yielded no butterflies. Much of the area is urbanised, and remaining unbuild areas are heavily weed infested and degraded. The species must now be considered extinct in the district.

#### Present records

- (f) Castlemaine. Billingham (1895) and Waterhouse and Lyell (1914) made references to Castlemaine (37°05'S, 144°13'E). The only early specimens, however, are one female labelled "Castlemaine, Vic., 20 Nov. 1907, Dr. Drake Collection" (ANIC) and one male labelled "Castlemaine, Vic., 10 Dec. 1907, Dr. Drake Collection" (ANIC). In December 1987, the Castlemaine population was rediscovered after it had apparently not been recorded for over 80 years: a small colony was found persisting in the same area (Crosby 1989). This is the only colony known to exist in the district.
- (g) Kiata. Six colonies currently occur at Kiata (36°22'S, 141°48'E) and a seventh occurs nearby at Salisbury. Early documented records were given by Crosby (1951a, 1965), Tindale (1953) and McCubbin (1971), although the population had been known to exist since the early 1930's (K. Hateley, pers. comm. 1987). A number of specimens collected during the 1950's and early 1960's by K. Hateley, D.F. Crosby, F.E. Parsons, F.E. Wilson, J.M. Landy and G. Forbes are lodged in MVM and ANIC.
- (h) Eltham, Greensborough. Colonies of *P. p. lucida* from the type locality near

Melbourne (Eltham-Greensborough district, around 37°43'S, 145°10'E) have received more attention than all other populations of the species. The earliest record is two male specimens (lodged in MVM) taken by F.E. Wilson at Eltham on 26 December 1939. Subsequently, a large number of specimens (held mostly in MVM, ANIC and JCU) were collected during the 1940's and 1950's by F.E. Wilson, A.N. Burns, J.C. Le Souef, D.F. Crosby, C.W. McCubbin, W.N.B. Quick, J.M. Landy and E.J. Harris. There are also three male specimens in BMNH labelled "Eltham, 6 Jan. 1957, H. Borch".

In 1971, Charles McCubbin warned that: "This race may soon become extinct since the restricted area (Eltham, Greensborough) where it is found is being developed for housing" (McCubbin, 1971). Between 1958 and 1981 no specimens of *P. p. lucida* were registered in scientific collections, although positive sightings were made by several local naturalists during this period. D.F. Crosby noted the butterfly as "common" on 25 January 1958, and B. Vardy (pers. comm. 1987) recorded the species at Eltham in 1972. On 31 January 1977, I.D. Endersby (pers. comm.) noted a colony at Montmorency (near Eltham), and he recorded subsequent sightings of butterflies. A colony, believed to be *P. p. lucida*, was located by C. Beardsell (pers. comm.) in 1982 at Yarrambat, approximately 9 km NNE of Greensborough. Beardsell later expressed concern about its likely future (Pugh *et al.*, 1983), the colony was subsequently destroyed by horses grazing the larval host plants. However, as no specimens were collected, the record needs confirmation: the butterflies observed may in fact have been *P. aurifera* (Blanchard) (bright copper) with which *P. p. lucida* could be confused easily.

Intensive searches by D.F. Crosby in the Eltham-Greensborough district during 1979-81 yielded no butterflies: many of the colonies from which specimens were originally collected during the 1940's and

1950's were eliminated by housing development. However, on 10 January 1982, a large but remnant colony was discovered in a bushland reserve at Greensborough (7 males lodged in ANIC). On 14 January 1986 M.F. Braby located a small remnant colony within a bushland reserve in the Eltham area. A further five colonies were subsequently located (Crosby 1987, Vaughan 1988), bringing the total known reservoir of extant colonies in the Eltham-Greensborough district to eight.

### Habitat preferences

The three remaining populations of *P. p. lucida* occurred in a variety of eucalypt woodland and dry open forest formations in which the understorey usually comprised a diverse array of native shrubs, herbs and grasses (Fig. 3). Within such sites the butterfly was very localised in extent, showing a marked preference for the drier, more open grassed microhabitats in which scattered stands and patches of the

diminutive form of the host plant *Bursaria spinosa* occurred. This localised distribution pattern was exemplified by colonies at Eltham-Greensborough where most colonies occurred on well drained elevated areas, usually on gentle slopes and ridges (often of northern aspect) adjacent to moister gullies with dense stands of the host plant. At Kiata, the colonies were on very gently sloping terrain with an overstorey of *E. largiflorens* F. Muell., *Allocasuarina huehmannii* (R. Baker) L. Johnson and some *E. leucoxyton* F. Muell. and *Callitris preissii* Miq. Further details on plant composition and vegetation structure are given by Vaughan (1988).

### Discussion

Information presented on the geographic distribution of *P. p. lucida* suggests the subspecies has suffered extensive range contraction. At least five populations have knowingly become extinct during the past century, viz: Goulburn Valley (Tallarook), Murtoa, Dimboola, Keilor and Broadmeadows; the remaining populations at the three known localities essentially represent relics of a taxon which undoubtedly was once locally common and more widespread. The subspecies now comprises a total of only sixteen colonies and its conservation status is vulnerable (Braby and Crosby, in press).

From the few records available it is difficult to assess the subspecies distribution and habitat requirements in detail. Prior to European settlement *P. p. lucida* was probably widespread, but localised, with populations restricted to areas of gentle sloping terrain in the foothills and plains of the Great Dividing Range which receive a mean annual rainfall of at least 420 to 750mm. The species clearly penetrated the now extensive 'wheat belt' inland of the Divide. Colonies at Eltham-Greensborough near Melbourne probably represented a disjunct population which occurred in similar habitat south of the Divide. The Keilor and Broadmeadows populations were probably restricted to woodland vegetation which once prevailed along gorges and sloping banks of stream



Fig. 3. Open forest habitat of *Paralucia pyrodiscus lucida* at the type locality Eltham - Greensborough showing *Eucalyptus macrorhyncha*, *E. goniocalyx* and *E. melliodora* overstorey. Photo: M.F. Braby.

valleys where the host plant occurred (Willis 1964) rather than on the basaltic grassland plains. Existence of colonies in the same sites at Kiata and Castlemaine for more than 50 and 90 years, respectively, indicate that populations are sedentary.

The cause of decline and factors contributing to the butterflies' rarity are largely unknown, they can only be implied from recent changes caused since European settlement. Nutritional constraints may mean that some lycaenid butterflies are very spatially patchy in distribution (Smiley *et al.* 1988) but this alone could not account for the extreme paucity of records. The major compounding factors appear related to habitat loss and urbanisation, both of which have contributed to substantial population decline and extinction for a number of rare lycaenid butterflies elsewhere in the world, for example, *Lycaena dispar dispar* Haw. in Britain (Duffey 1977), *Icaricia icariodes missionensis* near San Francisco, California (Orsak 1982) and *Plebejus argus* L. in Britain (Heath *et al.* 1984, Ravenscroft 1990). We suggest that habitat destruction through agriculture, particularly in areas north of the Great Divide (i.e. the wheat belt); urbanisation, especially where populations occurred near Melbourne; and possibly gold mining (and associated soil disturbance to host plants, larvae and attendant ant colonies), such as that which occurred in the Castlemaine district (Forster 1971), have adversely affected the status of *P. p. lucida*. Almost 60% of the original cover of forests and woodlands in Victoria has been cleared, largely for agricultural purposes (Frood and Calder 1987, Woodgate and Black 1988). Greatest habitat modification occurred in those areas most suitable for grazing, particularly in the Western, Wimmera and Northern plains - the region apparently most favoured by *P. p. lucida*. The extent to which *P. p. lucida* tolerates such large scale clearing and habitat disturbance presumably is very poor. This appears in contrast to northern populations of *P. p. pyrodiscus* which may thrive well in regularly disturbed open country, provided the larval host plants are

not depleted (A. Atkins pers. comm. 1992).

Preliminary morphological observations made on the male hindwing phenotype over the species broad geographic range clearly indicate that *P. pyrodiscus* is variable and further detailed study is required to examine this pattern of variation and to establish how much variability is attributed to environmental factors and genotype. It may be a long time before this is fully resolved, and until such time the subspecies *P. p. lucida* must at present be treated as a distinct taxon at risk in which the known populations are localised, geographically separated and biologically isolated by loss of intervening habitat. They thus provide an interesting example for studies of evolution and processes of speciation, and at very least, they merit strong conservation concern (New 1991).

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#### References

- Anderson, E. and Spry, E.P. (1893-94). 'Victorian Butterflies and How to Collect Them'. (H. Hearne & Co.: Melbourne).
- Atkins, A. (1974). Butterflies of Expedition Range, central Queensland. *Victorian Entomologist* 4(1): 9-14.
- Atkins, A. (1976). New records for butterflies in southern, central and northern Queensland. *Australian Entomological Magazine* 3: 1-4.
- Billinghurst, F.L. (1895). The fauna of the Castlemaine district - butterflies. *The Victorian Naturalist* 12: 91-93.
- Braby, M.F. (1990). The life history and biology of *Paralucia pyrodiscus lucida* Crosby (Lepidoptera: Lycaenidae). *Journal of the Australian Entomological Society* 29: 41-51.

- Braby, M.F. and Crosby, D.F. (in press). The status and conservation of the Eltham Copper Butterfly *Paralucia pyrodiscus lucida* Crosby in Victoria, Australia. *Journal of the Australian Entomological Society*.
- Common, I.F.B. and Waterhouse, D.F. (1972, revised edition 1981). 'Butterflies of Australia'. (Angus and Robertson: Sydney).
- Crosby, D.F. (1951a). A new geographical race of an Australian butterfly. *The Victorian Naturalist* 67: 225-227.
- Crosby, D.F. (1951b). Notes on some eastern Victorian butterflies with a new Victorian record. *The Victorian Naturalist* 68: 91-101.
- Crosby, D.F. (1965). Notes on some western Victorian butterflies. *Wings and Stings* August, 1965: 4-8.
- Crosby, D.F. (1987). The conservation status of the Eltham copper butterfly (*Paralucia pyrodiscus lucida* Crosby) (Lepidoptera: Lycaenidae) Technical Report Series No. 81. (Department of Conservation, Forests and Lands: Victoria 19pp).
- Crosby, D.F. (1989). Notes on the distribution of some butterflies in south-western Victoria. *Victorian Entomologist* 19: 74-78.
- Daniels, G. and Moulds, M.S. (1977). The butterflies of Warrumbungle National Park, New South Wales. *Australian Entomological Magazine* 4: 49-51.
- Duffey, E. (1977). The re-establishment of the Large copper butterfly, *Lycaena dispar batava* Obth. on Woodwalton Fen National Nature Reserve, Huntingdonshire. *Journal of Applied Ecology* 5: 69-96.
- Edwards, E.D. (1991). The nomenclature of *Paralucia pyrodiscus* (Doubleday) (Lepidoptera: Lycaenidae). *Australian Entomological Magazine* 18: 27-30.
- Forster, H.W. (1971). 'The Central Gold-Fields'. (Cypress Books: Melbourne).
- Frood, D. and Calder, M. (1987). Nature Conservation in Victoria. Study Report. (Victorian National Parks Association: Melbourne).
- Heath, J., Pollard, E. and Thomas, J.A. (1984). Atlas of Butterflies in Britain and Ireland. (Viking: Harmondsworth).
- Lee, D.M. (1982). Climate. In 'Atlas of Victoria', ch. 7, pp.26-31. (Victorian Government Printing Office: Melbourne).
- McCubbin, C. (1971). 'Australian Butterflies'. (Nelson: Melbourne).
- Monteith, G.B. and Yeates, D.K. (1986). The butterflies of Kroombit Tops, central Queensland. *The Queensland Naturalist* 27: 35-40.
- Monteith, G.B. and Yeates, D.K. (1988). The butterflies of Mount Moffatt and Carnarvon National Parks, Queensland. *The Queensland Naturalist* 28: 14-22.
- New, T.R. (1991). 'Butterfly Conservation'. (Oxford University Press: Melbourne).
- Orsak, L. (1982). San Bruno Mountain's \$800 million butterflies: the habitat conservation plan. *Wings* 9: 1-16.
- Pugh, C., Beardsell, C. and Beardsell, D. (1983). 'A Year of Orchids'. (Richard Griffin: Melbourne).
- Ravenscroft, N.O.M. (1990). The ecology and conservation of the Silver-studded Blue Butterfly *Plebejus argus* L. on the Sandlings of East Anglia, England. *Biological Conservation* 53: 21-36.
- Smiley, J.T., Atsatt, P.R. and Pierce, N.E. (1988). Local distribution of the lycaenid butterfly, *Jalmenus evagoras*, in response to host ants and plants. *Oecologia* 76: 416-422.
- Tindale, N.B. (1953). New Rhopalocera and a list of species from the Grampian mountains, western Victoria. *Records of the South Australia Museum* 11: 43-68.
- Vaughan, P.J. (1988). Management plan for the Eltham Copper Butterfly (*Paralucia pyrodiscus lucida* Crosby). Technical Report series No. 79. (Department of Conservation, Forests and Lands: Victoria. 54pp).
- Waterhouse, G.A. (1903). Notes on Australian Rhopalocera: Lycaenidae. Part III Revisional. *Proceedings of the Linnæan Society of New South Wales* 28: 132-275.
- Waterhouse, G.A. and Lyell, G. (1908). Some Dimboola butterflies. *The Victorian Naturalist* 24: 165-166.
- Waterhouse, G.A. and Lyell, G. (1914). 'The Butterflies of Australia'. (Angus and Robertson: Sydney).
- Willis, J.H. (1964). Vegetation of the basalt plains in western Victoria. *Proceedings of the Royal Society of Victoria* 77: 397-418.
- Wood, G.A. (1992). New distribution records for Lycaenidae (Lepidoptera) from northern Queensland. *Australian Entomological Magazine* 19: 28.
- Woodgate, P. and Black, P. (1988). 'Forest Cover Changes in Victoria 1869-1987'. (Department of Conservation, Forests and Lands: Melbourne).

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